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DEPARTMENT OF ECOLOGY

July 8, 1997

TO Carl Nuechterlein and David T Knight, ERO

FROM Art Johnson, EILS

SUBJECT 1996 RESULTS ON PCBs IN UPPER SPOKANE RIVER FISH
(Waterbody Numbers WA-54-1010, WA-54-1020, WA-57-1010)

Summary

Rainbow trout, mountain whitefish, and largescale suckers from the upper Spokane River were collected for PCB analysis in August 1996 to determine if concentrations had decreased from the levels seen in 1993-94. Samples were collected above Upriver Dam, above Monroe Street Dam, above Nine-Mile Dam, and in the Little Spokane River. In eight of the ten sample sets evaluated, mean PCB concentrations showed a consistent decrease from when first analyzed in 1993 or 1994. The decline in PCB concentrations was statistically significant in the four instances where there were sufficient data for testing.

Mean PCB concentrations in rainbow trout above Upriver Dam and in whitefish above Nine-Mile Dam were higher in 1996 than in 1994. The 1996 results for Upriver trout were strongly influenced by one outlier sample very high in PCBs. The increased concentrations found in Nine-Mile whitefish may be related to much larger individuals being analyzed than in past years. Both species from these two sites had lower mean concentrations compared to initial results from 1993.

Factors that may have broadly influenced the findings for 1996 include the unusually high river flows that preceded sample collection and the existence of continuing sources of PCBs. Source sampling conducted by EILS in November-December 1995 detected PCBs in effluents from the Kaiser Trentwood aluminum mill and wastewater from the Spokane Industrial Park, which goes to the City of Spokane treatment plant above Nine-Mile Dam. The final phases of cleanup at these facilities are to occur during the next permit cycle.

Although the 1996 results suggest PCB levels have decreased in both the upper Spokane and Little Spokane River, more than two to three years of data are needed before strong conclusions can be made. Fish from these areas continue to have elevated concentrations compared to other parts of the state. PCB concentrations still exceed levels considered

protective of wildlife and human health, the existence of significant human health concerns depending on the amount of fish in the diet

Recommendation

- Re-sample Spokane River fish for PCBs after cleanups are completed

Background

The Department of Ecology collected data on PCBs in Spokane River fish during 1993 and 1994 (Toxic Investigations Section, 1995). Based on these results, it was recommended that fish in the upper Spokane River be re-sampled in 1996 to determine if the level of contamination had decreased. This recommendation stemmed from an expectation that the apparent decline in PCB levels from 1993 to 1994 would continue due to corrective actions taken or planned by several industries. It also recognized that the concentrations found in 1994 remained sufficiently high to be a concern for wildlife and, potentially, human health. Additional sampling was also recommended for the Little Spokane River where PCB-1260 was the predominant mixture identified, compared to PCB-1254 in the main stem.

Results from the 1996 fish collection are reported here and compared to data from 1993-94. To the extent possible, sampling methods, sample size, and analytical methods for 1996 were identical to those of 1994. The sample size for 1994, and thus 1996, was selected to meet requirements of the Washington State Department of Health for purposes of assessing implications to human health. The 1993 survey was a screening study, where fewer numbers of samples were analyzed, methods were otherwise equivalent to 1994. All samples were collected by electroshocking during the first two weeks of August.

Figure 1 shows the locations that were sampled in 1993-94. In 1996, fish were collected from three sites on the main stem, above Upriver Dam, above the Monroe Street Dam, and above Nine-Mile Dam. Fish were also collected in the Little Spokane River, which was previously sampled in 1994 only. The species analyzed each year were rainbow trout, mountain whitefish, and largescale suckers. Each sample was a composite of five or more individuals. Skin-on fillets were analyzed for trout and whitefish, suckers were analyzed whole.

The reach from Monroe Dam to Upriver Dam is stocked yearly with rainbow trout. Fifty percent of the trout analyzed in the 1996 composite samples were marked fish. In 1994, the first time PCBs were analyzed in this reach, no marked fish were observed among the individuals analyzed (Dale Davis, personal communication).

The samples were analyzed by Bob Rieck of the EPA Manchester Laboratory using EPA Method 8080. Bob also analyzed the 1993-94 samples using the same method. Details of sample preparation and analytical methods can be found in the above cited report. Appendix A contains a case narrative on the 1996 data, evaluating adherence to sample holding times and results on procedural blanks, surrogate spikes, and matrix spikes. No significant problems were encountered with the analysis.

The data contained in this report have been given to Glen Patrick of the Washington State Department of Health (Johnson, 1997).

Results

Trends in the Data

The 1996 results for total PCBs in upper Spokane River fish are summarized as mean values in Table 1, along with comparable data from 1993-94. The distribution of the individual data points is plotted in Figure 2. Overall, 51 composite fish tissue samples have now been analyzed from this area: 21 rainbow trout, 18 mountain whitefish, and 12 largescale suckers. The complete Spokane River fish tissue data for 1993-96 are in Appendix B and C.

The evidence for a downward trend in PCB concentrations was evaluated by: 1) looking for a consistent decrease from year to year, and 2) testing for a statistically significant difference among or between years.

As shown in Table 1, the mean PCB concentrations in eight of the ten sample sets analyzed showed a consistent decline from when first analyzed in 1993 or 1994. The decreases observed were generally substantial, by a factor of two or more.

The two instances where mean PCB concentration did not decline were for rainbow trout above Upriver Dam and mountain whitefish above Nine-Mile Dam. As can be seen in Figure 2, the Upriver trout results for 1996 were strongly affected by a single outlier. This sample had 1,840 ug/Kg total PCBs vs. 215 and 313 ug/Kg in the other composites. A duplicate analysis of the high sample gave essentially the same results (Table 2, sample number 428096). The concentrations measured in Nine-Mile whitefish collected in 1996 were all consistently higher than in 1994. However, both species from these two sites had lower mean concentrations than when first analyzed in 1993.

Because multiple composites have been analyzed for trout and whitefish, the differences between years can be tested statistically. Two nonparametric tests were used, Mann-Whitney for two samples (years) and its extension for multiple samples, Kruskal-Wallis. Both tests are based on the rankings of total PCB concentrations in individual composite samples. These tests are more conservative (i.e., less likely to show a significant difference) than the parametric alternative, analysis of variance.

Results confirm that each of the downward trends that could be tested was statistically significant (Table 1). Because PCBs are lipid soluble, concentration differences between samples could be due to simple differences in lipid content. However, normalizing the PCB concentrations to the amount of lipid in these samples (Appendix B) did not alter the outcome.

Concentrations could also vary from year to year due to differences in the size classes (age) analyzed. Significant differences ($\geq 90\%$ probability, tested as above) in the size of fish used in the composite samples were limited to rainbow trout and whitefish from above Nine-Mile Dam. On average, larger rainbow trout were analyzed in 1994 and larger whitefish were analyzed in 1996 than in other years (Appendix B). The substantial changes observed for these species at this site between 1994 and 1996 (PCBs decreased in trout but increased in whitefish) may bear some relation to the size of the fish analyzed.

With limited numbers of samples being analyzed from each site, and only two or three years of data, it is not possible to make strong conclusions about trends. Two additional factors that are likely to have broadly influenced the 1996 results are: 1) the unusually high river flow during February (to 35,500 cfs) and April-May (to 26,200 cfs), and 2) the existence of continuing sources of PCBs to the river.

Monitoring data collected by EILS during November-December 1995 suggest PCBs are still being released to the Spokane River (Golding, 1996). PCB-1248 was detected in the 001 discharge from Kaiser Trentwood aluminum mill above Upriver Dam and in wastewater from the Spokane Industrial Park, which goes to the City of Spokane treatment plant above Nine-Mile Dam. PCB-1248 was also detected in sludge from the Liberty Lake WWTP upstream of Kaiser, but concentrations were much lower than in 1994 (220-300 ug/Kg vs. 4,400 ug/Kg).

With each year of data collected the effects of random events such as extreme flows are diminished. However, additional fish sampling for purposes of determining trends in PCB contamination may be of limited value until the cleanups scheduled for the next permit cycle are completed.

Little Spokane River

When fish were first sampled from the Little Spokane River in 1994 it was noted that PCB-1260 accounted for 59-74% of the total PCB concentrations. This finding, coupled with the elevated levels of 145-440 ug/Kg total PCBs, suggested the presence of a source of -1260 in the watershed. The re-sampling done in 1996 shows approximately the same relative percentage of PCB-1260 in Little Spokane fish (Figure 3). Although concentrations are somewhat lower, 135-366 ug/Kg, they indicate a source may still exist.

Implications for Wildlife and Human Health

Table 3 summarizes environmental criteria and guidelines pertinent to the issue of PCB contamination in fish. The Great Lakes criteria of 50 and 220 ug/Kg, shown near the bottom of the table, were used by the Washington State Department of Health to assess human health implications of PCBs in lower Columbia River fish (Laflamme. 1996).

When the values in Table 3 are compared to the results obtained for the Spokane River in 1996, the following can be concluded

- Upper Spokane River and Little Spokane River fish continue to have higher concentrations of total PCBs than typically encountered in other parts of the state, and in most cases exceed the state 85th percentile. Concentrations are also elevated on a nation-wide perspective
- PCB concentrations still exceed levels considered protective of fish-eating wildlife
- The EPA human health criterion under which the Spokane and Little Spokane are listed as water quality limited (303(d)) for PCBs, continues to be exceeded by two orders of magnitude
- If individuals regularly consume fish from the Spokane River, the PCB concentrations could be a human health concern, depending on the amount eaten.

Acknowledgments

Fish samples for this study were collected with the assistance of Dave Serdar and John Summers. The work of Bob Rieck and other Manchester Laboratory staff in analyzing the Spokane River fish tissue samples is very much appreciated.

References

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Maps by EIS 295

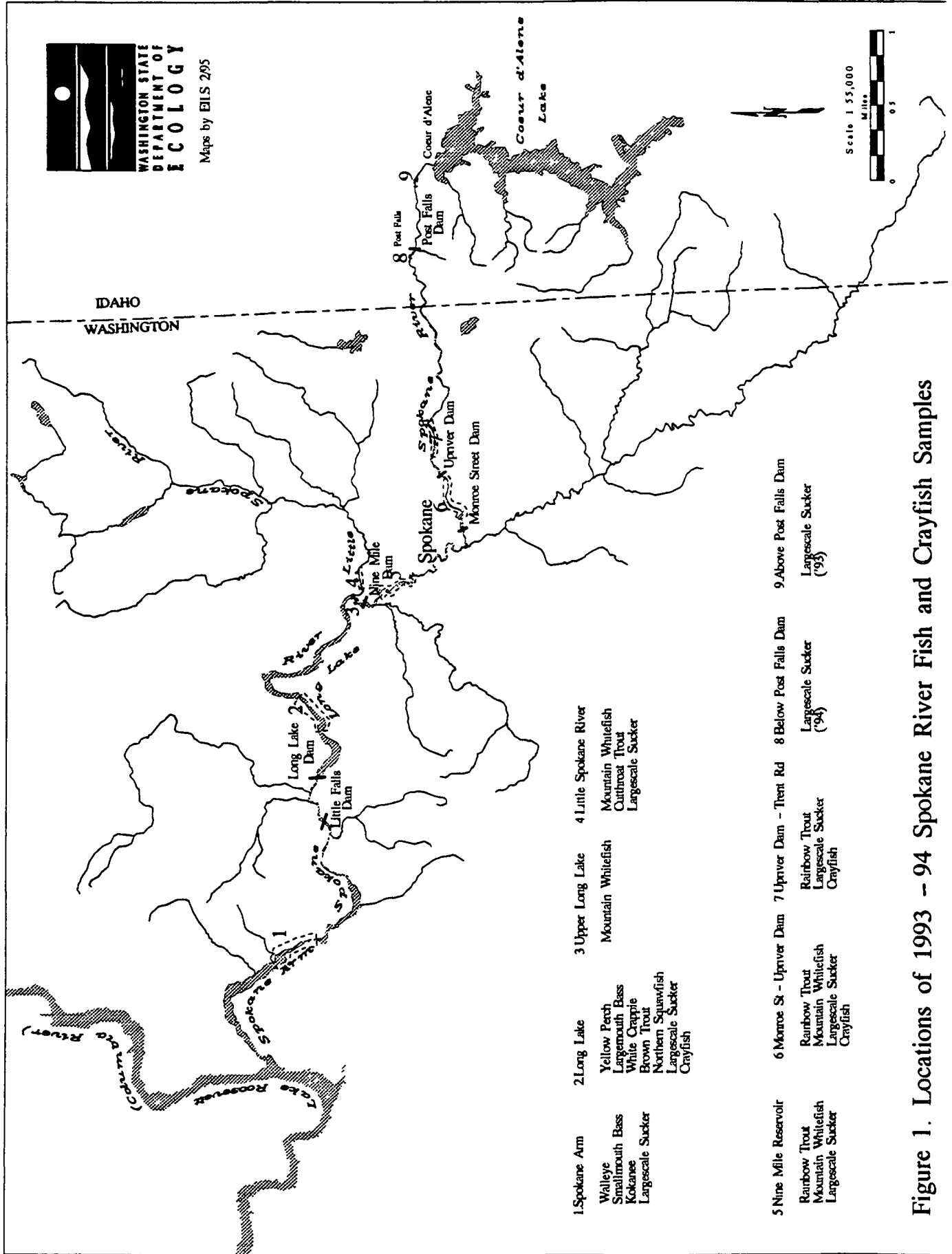


Figure 1. Locations of 1993 - 94 Spokane River Fish and Crayfish Samples

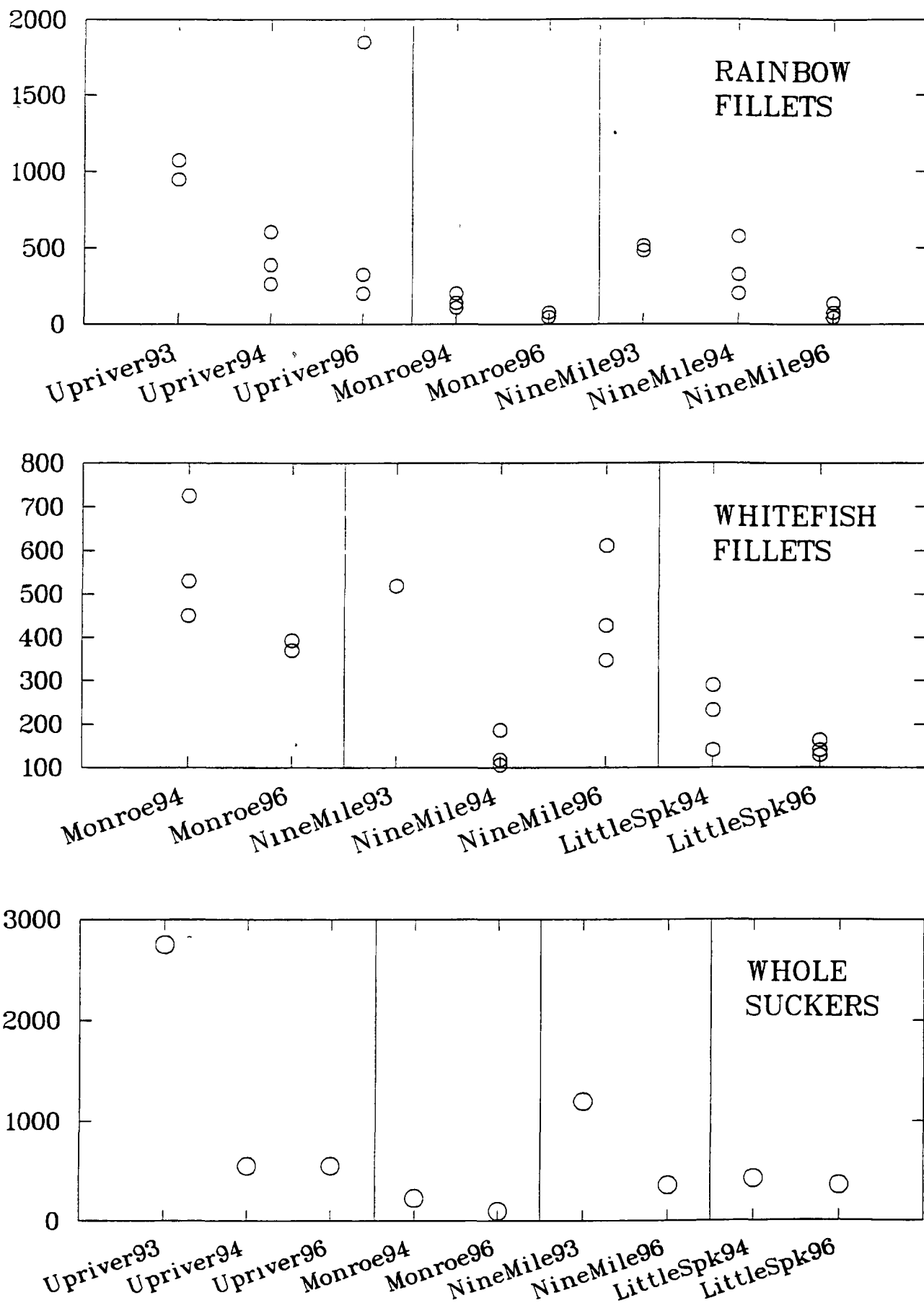


Figure 2. Total PCBs in Upper Spokane Fish, 1993–96 (ug/Kg)

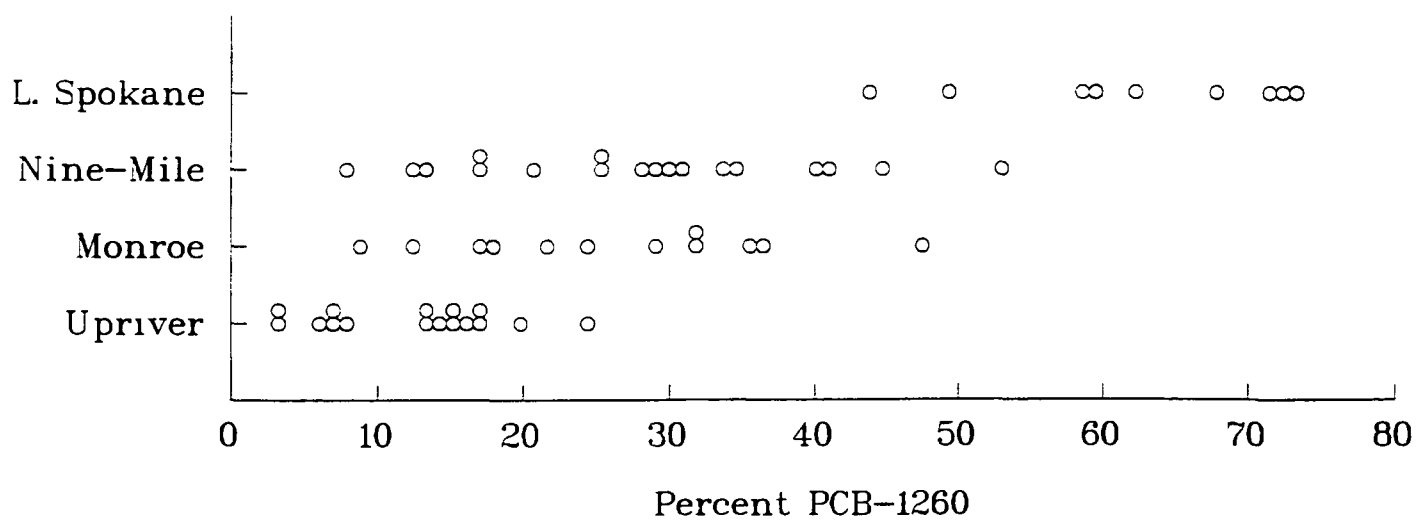


Figure 3. Relative Amount of PCB-1260 in 1993-96 Fish Samples

Table 1. Trend Indications for Total PCBs in Upper Spokane River Fish (ug/Kg, wet weight)

| Location | Species | 1993 mean | 1994 mean | 1996 mean | N = | Apparent Downward Trend? | Statistically Significant?* |
|----------------------|--------------------|--------------|--------------|--------------|-----|--------------------------------|--------------------------------|
| Ab Upriver Dam | Largescale Sucker | 2780 | 531 | 520 | 3 | yes | insuff. data |
| | Rainbow Trout | 1020 | 424 | 790 | 8 | no | - - |
| Ab Monroe Dam | Largescale Sucker | 201 | ns | 116 | 3 | yes | insuff. data |
| | Rainbow Trout | ns | 152 | 76 | 5 | yes | yes |
| | Mountain Whitefish | ns | 568 | 381 | 5 | yes | yes |
| Ab Nine-Mile Dam | Largescale Sucker | 1210 | ns | 345 | 3 | yes | insuff. data |
| | Rainbow Trout | 490 | 371 | 76 | 8 | yes | yes |
| | Mountain Whitefish | 522 | 139 | 463 | 7 | no | - - |
| Little Spokane River | Largescale Sucker | ns | 440 | 366 | 3 | yes | insuff. data |
| | Mountain Whitefish | ns | 222 | 145 | 6 | yes | yes |

* $\geq 90\%$ probability, Mann-Whitney/Kruskal-Wallis test

ns = no samples

Table 2. Precision of PCB Data on Spokane River Fish

| Species | Year | Sample Number | Total PCBs (ug/Kg) | | Relative Percent Difference* |
|--------------------|------|---------------|--------------------|-------------|------------------------------|
| | | | Analysis #1 | Analysis #2 | |
| Rainbow Trout | 1994 | 318260 | 393 | 377 | 4.1% |
| " " | 1994 | 318261/328437 | 740 | 471 | 44% |
| " " | 1996 | 428096 | 1870 | 1812 | 3.2% |
| Mountain Whitefish | 1996 | 428087 | 673 | 560 | 18% |
| Largescale Sucker | 1993 | 318243 | 2780 | 2770 | 0.4% |
| " " | 1994 | 428099 | 530 | 510 | 3.8% |
| Yellow Perch | 1993 | 318251 | 9.6 | 9.2 | 4.3% |

*range of duplicates as percent of mean

Table 3. Environmental Criteria and Guidelines for PCBs in Fish (ug/Kg)

| Total PCBs | Criteria/Guideline | Source | Reference |
|--------------------------------|--|---|-------------------------|
| <u>STATE AND NATIONAL DATA</u> | | | |
| 67 | Wash state mean - fillets | Dept of Ecology, | Davis & Serdar |
| 103 | Wash. state mean - whole fish | Washington State | (1996) |
| 120 | Wash state 85 th percentile - fillets | Pesticide Monitoring | |
| 225 | Wash state 85 th percentile - whole fish | Program | |
| 47 | U.S background, fillets & whole fish | EPA National Study | EPA (1992) |
| 209 | U S median, fillets & whole fish | | |
| <u>WILDLIFE</u> | | | |
| 100 | Protect fish-eating birds & mammals | IJC Great Lakes Goal | IJC (1975) |
| 110 | Protect fish-eating wildlife | Niagara River Fish Flesh Criteria | Newell et al. (1987) |
| 500 | Protect aquatic life | Nation Acad. Sciences Recommendation | NAS (1973) |
| <u>HUMAN HEALTH</u> | | | |
| 1 4* | To determine need for more intensive monitoring | EPA Screening Level | EPA (1995) |
| 1 4* | Criterion for listing as water-quality limited (303(d)) | EPA National Toxics Rule | 40 CFR Part 131 |
| 50 | Health protective value (@140g/day) | Great Lakes Sport Fish | GLSFATF |
| 220 | Health protective value (@ 32g/day) | Advisory Task Force | (1993) |
| 2,000 | Legal limit for removing fish from market place | FDA Tolerance Level | FDA (1984) |

*for a 10⁻⁶ increased life-time cancer risk

Appendix A

MANCHESTER ENVIRONMENTAL LABORATORY

7411 Beach Drive E , Port Orchard Washington 98366

CASE NARRATIVE


February 7, 1997

Subject: Spokane PCBs

Samples: 96 -428080 to -428099

Case No. 1697-96

Officer: Art Johnson

By: Dickey D Huntamer 
Organics Analysis Unit

POLYCHLORINATED BIPHENYLS

ANALYTICAL METHODS:

The tissue samples were extracted using acetone as the solvent followed by Florisil column cleanup. Analysis was done by EPA Method 8080 using dual column capillary GC analysis with Electron Capture Detectors (ECD).

HOLDING TIMES:

The samples were stored frozen until extracted. After extraction analysis was completed within forty days. All extraction and analysis holding times were met.

BLANKS:

No target compounds were detected in the laboratory blanks.

SURROGATES:

All surrogates recoveries were within the acceptable limits of 50 to 150%.

MATRIX SPIKE AND MATRIX SPIKE :

Matrix spike recoveries ranged from 79% to 91% and were within acceptable limits. The Relative Percent Differences (RPD) ranged from 2.5% to 5.6%.

ANALYTICAL COMMENTS:

The samples were initially extracted and analyzed in November 1996 however a problem was discovered with the Florisil cleanup. This resulted in incorrect partitioning of the Florisil fractions and low recoveries for the surrogate compounds. Since frozen sample was still available for reanalysis the samples were re-extracted and analyzed in January.

There were no significant problems with the second PCB analysis and the data is acceptable as qualified.

DATA QUALIFIER CODES:

| | | |
|-------------|---|--|
| U | - | The analyte was not detected at or above the reported value. |
| J | - | The analyte was positively identified. The associated numerical value is an <u>estimate</u> . |
| UJ | - | The analyte was not detected at or above the reported estimated result. |
| REJ | - | The data are <u>unusable</u> for all purposes. |
| EXP | - | The result is equal to the number before EXP times 10 to the power of the number after EXP. As an example 3EXP6 equals 3×10^6 . |
| NAF | - | Not analyzed for. |
| N | - | For organic analytes there is evidence the analyte is present in this sample. |
| NJ | - | There is evidence that the analyte is present. The associated numerical result is an estimate. |
| E | - | This qualifier is used when the concentration of the associated value exceeds the known calibration range. |
| bold | - | The analyte was present in the sample. (Visual Aid to locate detected compound on report sheet.) |

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Appendix B. Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

| Location | Date | Species | Sample Type | Sample Number | PCB Concentrations | | | Percent Lipid | Number of Fish in Composite | Mean Total Length (mm) | Mean Weight (grams) |
|---------------------|---------|---------|-------------|---------------|--------------------|-------|-------|---------------|--------------------------------|------------------------|---------------------|
| | | | | | -1248 | -1254 | -1260 | | | | |
| Above Idaho Border | 8/9/93 | LSS | WF | 318244 | <28 | 55 | 41 | 7.2 | 1 | 411 | 802 |
| " | 8/10/94 | LSS | WF | 328435 | <39 | 81 | 71 | 5.5 | 5 | 495 | 1343 |
| Above Upriver Dam | 7/27/93 | LSS | WF | 318243 | 800 | 1800 | 180 | 4.3 | 5 | 434 | 837 |
| " | 7/27/93 | LSS | WF | 318243D | 800 | 1800 | 170 | na | (duplicate analysis of 318243) | | |
| " | 8/6/94 | LSS | WF | 318263 | 230 | 230 | 71 | 3.6 | 5 | 417 | 745 |
| " | 8/14/96 | LSS | WF | 428099 | 140 | 260 | 130 | 3.7 | 5 | 430 | 764 |
| " | 8/14/96 | LSS | WF | 428099D | 150 | 260 | 100 | 3.5 | (duplicate analysis of 428099) | | |
| " | 7/27/93 | RBT | F | 318255 | 400 | 610 | 74 | 1.9 | 5 | 363 | 481 |
| " | 7/27/93 | RBT | F | 318256 | 400 | 550 | <78 | 1.7 | 5 | 288 | 267 |
| " | 8/6/94 | RBT | F | 318260 | 133 | 197 | 63 | 2.9 | 8 | 354 | 444 |
| " | 8/6/94 | RBT | F | 318260D | 127 | 193 | 57 | na | (duplicate analysis of 318260) | | |
| " | 8/6/94 | RBT | F | 318261 | 240 | 390 | 110 | 2.5 | 8 | 319 | 358 |
| " | 8/6/94 | RBT | F | 328437 | 172 | 218 | 81 | 2.8 | (duplicate analysis of 318261) | | |
| " | 8/6/94 | RBT | F | 318262 | 130 | 110 | 40 | 3.7 | 8 | 305 | 320 |
| " | 8/14/96 | RBT | F | 428096 | 1020 | 790 | 60 | 2.2 | 8 | 303 | 354 |
| " | 8/14/96 | RBT | F | 428096D | 980 | 770 | 62 | 2.1 | (duplicate analysis of 428096) | | |
| " | 8/14/96 | RBT | F | 428097 | 130 | 140 | 43 | 2.4 | 8 | 290 | 319 |
| " | 8/14/96 | RBT | F | 428098 | 94 | 85 | 36 | 2.2 | 8 | 317 | 359 |
| " | 8/6/94 | CRF | M | 318264 | <8 | <8 | <8 | 0.1 | 8 | -- | 67 |
| " | 8/6/94 | CRF | M | 318265 | <7 | <7 | <7 | 0.2 | 8 | -- | 65 |
| " | 8/6/94 | CRF | M | 318266 | <6 | <6 | 7 | 0.1 | 8 | -- | 55 |
| Above Monore St Dam | 8/8/94 | LSS | WF | 328431 | 34 | 96 | 71 | 1.2 | 5 | 416 | 667 |
| " | 8/14/96 | LSS | WF | 428095 | 34 | 45 | 37 | 0.8 | 5 | 395 | 607 |
| " | 8/8/94 | RBT | F | 328425 | 29 | 67 | 88 | 1.2 | 8 | 293 | 270 |
| " | 8/8/94 | RBT | F | 328426 | 27 | 44 | 40 | 1.1 | 7 | 263 | 196 |
| " | 8/8/94 | RBT | F | 328427 | 39 | 71 | 51 | 1.2 | 7 | 242 | 153 |
| " | 8/14/96 | RBT | F | 428093 | 26 | 26 | 21 | 1.5 | 7 | 262 | 185 |
| " | 8/14/96 | RBT | F | 428094 | 28 | 33 | 17 | 1.1 | 7 | 251 | 163 |

Appendix B. [continued] Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

| Location | Date | Species | Sample Type | Sample Number | PCB Concentrations | | | Percent Lipid | Number of Fish in Composite | Mean Total Length (mm) | Mean Weight (grams) |
|----------------------|---------|---------|-------------|---------------|--------------------|-------|-------|---------------|--------------------------------|------------------------|---------------------|
| | | | | | -1248 | -1254 | -1260 | | | | |
| Above Monore St Dam | 8/8/94 | MWF | F | 328428 | 139 | 261 | 130 | 5.6 | 7 | 287 | 237 |
| " | 8/8/94 | MWF | F | 328429 | 99 | 311 | 39 | 5.5 | 8 | 300 | 257 |
| " | 8/8/94 | MWF | F | 328430 | 174 | 462 | 89 | 4.6 | 8 | 288 | 232 |
| " | 8/14/96 | MWF | F | 428091 | 110 | 220 | 68 | 4.2 | 5 | 289 | 210 |
| " | 8/14/96 | MWF | F | 428092 | 77 | 220 | 67 | 3.9 | 5 | 299 | 216 |
| " | 8/8/94 | CRF | M | 328432 | <7 | <7 | <7 | 0.2 | 8 | -- | 60 |
| " | 8/8/94 | CRF | M | 328433 | <7 | <7 | <7 | 0.3 | 8 | -- | 56 |
| " | 8/8/94 | CRF | M | 328434 | <7 | <7 | <7 | 0.2 | 8 | -- | 60 |
| Above Nine-Mile Dam | 8/10/93 | LSS | WF | 318242 | 400 | 600 | 210 | 5.6 | 5 | 517 | 1460 |
| " | 8/13/96 | LSS | WF | 428090 | 75 | 170 | 100 | 2.1 | 5 | 449 | 1029 |
| " | 8/10/93 | RBT | F | 318252 | 200 | 210 | 64 | 2.7 | 4 | 342 | 410 |
| " | 8/10/93 | RBT | F | 318253 | 200 | 240 | 65 | 2.9 | 4 | 262 | 164 |
| " | 8/5/94 | RBT | F | 318254 | 52 | 98 | 170 | 5.4 | 6 | 407 | 788 |
| " | 8/5/94 | RBT | F | 318255 | 44 | 76 | 85 | 3.0 | 6 | 396 | 709 |
| " | 8/5/94 | RBT | F | 318256 | 59 | 410 | 120 | 5.2 | 6 | 421 | 881 |
| " | 8/13/96 | RBT | F | 428084 | 19 | 28 | 16 | 1.5 | 5 | 272 | 252 |
| " | 8/13/96 | RBT | F | 428085 | 28 | 60 | 40 | 1.7 | 6 | 289 | 302 |
| " | 8/13/96 | RBT | F | 428086 | 15 | 17 | 6.4 | 1.5 | 5 | 267 | 231 |
| " | 8/10/93 | MWF | F | 318254 | 200 | 280 | 42 | 2.7 | 5 | 242 | 122 |
| " | 8/5/94 | MWF | F | 318257 | 56 | 30 | 34 | 6.9 | 8 | 234 | 117 |
| " | 8/5/94 | MWF | F | 318258 | 43 | 35 | 33 | 8.4 | 8 | 243 | 142 |
| " | 8/5/94 | MFW | F | 318259 | 91 | 20 | 74 | 6.6 | 8 | 259 | 182 |
| " | 8/13/96 | MWF | F | 428087 | 100 | 270 | 190 | 4.5 | 8 | 327 | 317 |
| " | 8/13/96 | MWF | F | 428087D | 93 | 280 | 300 | 4.4 | (duplicate analysis of 428087) | | |
| " | 8/13/96 | MWF | F | 428088 | 110 | 210 | 110 | 5.5 | 8 | 307 | 277 |
| " | 8/13/96 | MWF | F | 428089 | 83 | 140 | 120 | 5.1 | 8 | 305 | 270 |
| Little Spokane River | 8/3/94 | LSS | WF | 318236 | 40 | 140 | 260 | 4.3 | 5 | 453 | 935 |
| " | 8/13/96 | LSS | WF | 428083 | 46 | 160 | 160 | 1.3 | 5 | 453 | 968 |
| " | 8/3/94 | MWF | F | 318237 | 20 | 35 | 90 | 2.5 | 8 | 318 | 289 |

Appendix B. [continued] Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

| Location | Date | Species | Sample Type | Sample Number | PCB Concentrations | | | Percent Lipid | Number of Fish in Composite | Mean Total Length (mm) | Mean Weight (grams) |
|----------------------|---------|---------|-------------|---------------|--------------------|-------|-------|---------------|--------------------------------|------------------------|---------------------|
| | | | | | -1248 | -1254 | -1260 | | | | |
| Little Spokane River | 8/3/94 | MWF | F | 318238 | 20 | 45 | 170 | 2.2 | 8 | 271 | 183 |
| " | 8/3/94 | MWF | F | 318239 | 25 | 50 | 210 | 3.2 | 8 | 279 | 207 |
| " | 8/13/96 | MWF | F | 428080 | 23 | 60 | 81 | 4.2 | 8 | 290 | 239 |
| " | 8/13/96 | MWF | F | 428081 | 9.1 | 30 | 97 | 3.0 | 8 | 263 | 173 |
| " | 8/13/96 | MWF | F | 428082 | 15 | 29 | 91 | 2.0 | 8 | 269 | 173 |
| " | 8/3/94 | CTT | F | 318242 | 23 | 55 | 110 | 3.5 | 1 | 345 | 420 |
| Long Lake | 7/27/93 | LSS | WF | 318241 | 100 | 180 | 130 | 2.3 | 5 | 469 | 967 |
| " | 8/2/94 | LSS | WF | 318248 | 140 | 410 | 270 | 3.4 | 8 | 468 | 1005 |
| " | 7/27/93 | MWF | F | 318250 | 200 | 410 | 170 | 3.5 | 5 | 309 | 242 |
| " | 8/2/94 | MWF | F | 318249 | 38 | 62 | 60 | 3.6 | 8 | 252 | 152 |
| " | 8/2/94 | MWF | F | 318250 | 23 | 38 | 57 | 3.4 | 7 | 247 | 138 |
| " | 8/2/94 | MWF | F | 318251 | 18 | 19 | 34 | 1.9 | 7 | 231 | 101 |
| " | 7/27/93 | LMB | F | 318249 | <45 | 74 | 23 | 0.6 | 5 | 394 | 1093 |
| " | 8/2/94 | LMB | F | 318240 | 20 | 38 | 36 | 1 | 5 | 361 | 841 |
| " | 8/2/94 | LMB | F | 318247 | 27 | 53 | 24 | 1.1 | 5 | 372 | 906 |
| " | 7/7/93 | YLP | F | 318251 | <10 | 9.2 | <7 | 0.2 | 5 | 181 | 162 |
| " | 7/7/93 | YLP | F | 318251D | <10 | 9.6 | <7 | na | (duplicate analysis of 318251) | | |
| " | 8/2/94 | YLP | F | 318244 | <6 | 9 | <6 | 0.2 | 8 | 237 | 190 |
| " | 8/2/94 | YLP | F | 318245 | <6 | 10 | 6 | 0.2 | 8 | 245 | 218 |
| " | 8/2/94 | YLP | F | 318246 | <6 | 6 | <6 | 0.2 | 8 | 223 | 167 |
| " | 8/2/94 | BRT | F | 318241 | 40 | 90 | 63 | 4 | 3 | 309 | 327 |
| " | 8/2/94 | WCP | F | 318243 | 22 | 46 | 29 | 2.5 | 7 | 237 | 282 |
| " | 8/2/94 | WCP | F | 328436 | 24 | 42 | 32 | 2.5 | (duplicate analysis of 318243) | | |
| " | 8/2/94 | NSQ | F | 318233 | 40 | 150 | 110 | 1.5 | 8 | 382 | 505 |
| " | 8/2/94 | NSQ | F | 318234 | 30 | 100 | 76 | 1.6 | 8 | 384 | 475 |
| " | 8/2/94 | NSQ | F | 318235 | 30 | 100 | 70 | 1.2 | 8 | 388 | 484 |
| " | 8/2/94 | CRF | M | 318253 | <9 | <9 | <9 | na | 3 | -- | 63 |
| " | 7/7/93 | CRF | M | 318248 | <17 | <17 | <17 | 0.4 | 5 | -- | 56 |

Appendix B. [continued] Ecology Data on PCBs in Spokane River Fish, 1993 - 1996 (ug/Kg, wet weight)

| Location | Date | Species | Sample Type | Sample Number | PCB Concentrations | | | Percent Lipid | Number of Fish in Composite | Mean Total Length (mm) | Mean Weight (grams) |
|-------------|---------|---------|-------------|---------------|--------------------|-------|-------|---------------|-----------------------------|------------------------|---------------------|
| | | | | | -1248 | -1254 | -1260 | | | | |
| Spokane Arm | 7/26/93 | LSS | WF | 318240 | 200 | 250 | 190 | 5.1 | 5 | 434 | 1272 |
| " | 7/26/93 | WAL | F | 318245 | <9 | 15 | <9 | 0.4 | 5 | 318 | 255 |
| " | 7/26/93 | SMB | F | 318247 | <20 | 28 | <7 | 1.2 | 5 | 230 | 211 |
| " | 7/26/93 | KOK | F | 318246 | <50 | 70 | 22 | 4.4 | 2 | 240 | 172 |
| " | 8/2/94 | WAL | F | 318230 | <7 | 20 | 11 | 0.9 | 8 | 263 | 165 |
| " | 8/2/94 | WAL | F | 318231 | 15 | 30 | 13 | 0.8 | 8 | 257 | 148 |
| " | 8/2/94 | WAL | F | 318232 | 14 | 25 | 11 | 0.9 | 8 | 299 | 197 |

D = duplicate analysis

LSS = largescale sucker WF = whole fish
 RBT = rainbow trout F = fillet (skin on)
 CRF = crayfish M = muscle
 MWF = mountain whitefish na = not analyzed
 CTT = cutthroat trout
 LMB = largemouth bass
 YLP = yellow perch
 BRT = brown trout
 WCP = white crappie
 NSQ = northern squawfish
 WAL = walleye
 SMB = smallmouth bass
 KOK = kokanee

Appendix C. Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

| Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) | Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) |
|-------------------|---------|---------------|------------------------|---------------------|-------------------|---------|---------------|------------------------|---------------------|
| Above Upriver Dam | | | | | Above Upriver Dam | | | | |
| 7/27/93 | LSS | 318243 | 505 | 1367 | 8/6/94 | RBT | 318262 | 285 | 284 |
| | | | 406 | 637 | | | | 350 | 444 |
| | | | 427 | 721 | | | | 300 | 296 |
| | | | 410 | 739 | | | | 341 | 453 |
| | | | 420 | 723 | | | | 276 | 195 |
| 8/6/94 | LSS | 318263 | 377 | 525 | | | | 350 | 449 |
| | | | 399 | 653 | | | | 319 | 325 |
| | | | 410 | 680 | | | | 218 | 118 |
| | | | 485 | 1188 | 8/14/96 | RBT | 428096 | 414 | 875 |
| | | | 415 | 680 | | | | 254 | 158 |
| 8/14/96 | LSS | 428099 | 445 | 933 | | | | 260 | 189 |
| | | | 391 | 573 | | | | 276 | 258 |
| | | | 424 | 786 | | | | 238 | 143 |
| | | | 421 | 713 | | | | 374 | 598 |
| | | | 467 | 813 | | | | 330 | 391 |
| 7/27/93 | RBT | 318255 | 373 | 498 | | | | 275 | 219 |
| | | | 360 | 528 | 8/14/96 | RBT | 428097 | 243 | 168 |
| | | | 333 | 374 | | | | 225 | 115 |
| | | | 386 | 541 | | | | 239 | 159 |
| | | | 365 | 464 | | | | 240 | 156 |
| 7/27/93 | RBT | 318256 | 280 | 241 | | | | 262 | 205 |
| | | | 285 | 255 | | | | 413 | 770 |
| | | | 240 | 161 | | | | 339 | 471 |
| | | | 331 | 393 | | | | 362 | 505 |
| | | | 305 | 286 | 8/14/96 | RBT | 428098 | 321 | 359 |
| 8/6/94 | RBT | 318260 | 454 | 915 | | | | 370 | 578 |
| | | | 319 | 358 | | | | 348 | 469 |
| | | | 331 | 395 | | | | 366 | 430 |
| | | | 275 | 197 | | | | 277 | 241 |
| | | | 428 | 701 | | | | 347 | 469 |
| | | | 389 | 262 | | | | 265 | 163 |
| | | | 284 | 279 | | | | 239 | 162 |
| | | | 353 | 445 | | | | | |
| 8/6/94 | RBT | 318261 | 310 | 317 | | | | | |
| | | | 325 | 411 | | | | | |
| | | | 225 | 130 | | | | | |
| | | | 313 | 308 | | | | | |
| | | | 323 | 329 | | | | | |
| | | | 335 | 388 | | | | | |
| | | | 318 | 298 | | | | | |
| | | | 400 | 679 | | | | | |

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

| Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) | Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) |
|---------------------|---------|---------------|------------------------|---------------------|---------------------|---------|---------------|------------------------|---------------------|
| Above Monroe St Dam | | | | | Above Monroe St Dam | | | | |
| 8/8/94 | LSS | 328431 | 386 | 516 | 8/14/96 | RBT | 428094 | 263 | 158 |
| | | | 453 | 793 | | | | 300 | 269 |
| | | | 406 | 677 | | | | 267 | 174 |
| | | | 430 | 744 | 8/8/94 | MWF | 328428 | 326 | 340 |
| | | | 403 | 603 | | | | 305 | 259 |
| 8/14/96 | LSS | 428095 | 406 | 624 | | | | 218 | 105 |
| | | | 453 | 801 | | | | 295 | 222 |
| | | | 399 | 674 | | | | 319 | 323 |
| | | | 380 | 540 | | | | 302 | 263 |
| | | | 335 | 395 | | | | 242 | 144 |
| 8/8/94 | RBT | 328425 | 280 | 207 | 8/8/94 | MWF | 328429 | 322 | 293 |
| | | | 309 | 293 | | | | 311 | 275 |
| | | | 224 | 120 | | | | 230 | 125 |
| | | | 352 | 419 | | | | 285 | 206 |
| | | | 296 | 262 | | | | 307 | 269 |
| | | | 321 | 322 | | | | 318 | 246 |
| | | | 195 | 67 | | | | 307 | 324 |
| | | | 370 | 472 | | | | 319 | 316 |
| 8/8/94 | RBT | 328426 | 197 | 79 | 8/8/94 | MWF | 328430 | 317 | 278 |
| | | | 300 | 265 | | | | 298 | 270 |
| | | | 339 | 355 | | | | 335 | 312 |
| | | | 192 | 62 | | | | 340 | 334 |
| | | | 296 | 287 | | | | 235 | 126 |
| | | | 247 | 160 | | | | 307 | 287 |
| | | | 268 | 163 | | | | 230 | 115 |
| 8/8/94 | RBT | 328427 | 220 | 109 | | | | 246 | 136 |
| | | | 280 | 233 | 8/14/96 | MWF | 428091 | 282 | 217 |
| | | | 286 | 263 | | | | 311 | 232 |
| | | | 217 | 104 | | | | 280 | 191 |
| | | | 240 | 131 | | | | 269 | 168 |
| | | | 229 | 136 | | | | 305 | 240 |
| | | | 221 | 94 | 8/14/96 | MWF | 428092 | 312 | 254 |
| 8/14/96 | RBT | 428093 | 196 | 80 | | | | 285 | 219 |
| | | | 205 | 101 | | | | 304 | 231 |
| | | | 280 | 227 | | | | 287 | 162 |
| | | | 264 | 151 | | | | 305 | 214 |
| | | | 270 | 176 | | | | | |
| | | | 318 | 303 | | | | | |
| | | | 298 | 259 | | | | | |
| 8/14/96 | RBT | 428094 | 194 | 72 | | | | | |
| | | | 202 | 93 | | | | | |
| | | | 253 | 140 | | | | | |
| | | | 281 | 236 | | | | | |

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

| Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) | Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) |
|---------------------|---------|---------------|------------------------|---------------------|---------------------|---------|---------------|------------------------|---------------------|
| Above Nine-Mile Dam | | | | | Above Nine-Mile Dam | | | | |
| 8/10/93 | LSS | 318242 | 553 | 1834 | 8/13/96 | RBT | 428085 | 251 | 160 |
| | | | 539 | 1691 | | | | 264 | 235 |
| | | | 542 | 1530 | | | | 285 | 284 |
| | | | 504 | 1354 | | | | 257 | 183 |
| | | | 447 | 889 | | | | 415 | 729 |
| 8/13/96 | LSS | 428090 | 426 | 966 | | | | 259 | 220 |
| | | | 455 | 1087 | 8/13/96 | RBT | 428086 | 260 | 201 |
| | | | 418 | 937 | | | | 306 | 337 |
| | | | 474 | 1094 | | | | 260 | 224 |
| | | | 473 | 1061 | | | | 248 | 187 |
| 8/10/93 | RBT | 318252 | 384 | 608 | | | | 260 | 208 |
| | | | 295 | 237 | 8/10/93 | MWF | 318254 | 249 | 131 |
| | | | 334 | 364 | | | | 249 | 144 |
| | | | 356 | 432 | | | | 245 | 122 |
| 8/10/93 | RBT | 318253 | 284 | 221 | | | | 235 | 104 |
| | | | 293 | 171 | | | | 232 | 111 |
| | | | 232 | 135 | 8/5/94 | MWF | 318257 | 245 | 149 |
| | | | 238 | 129 | | | | 238 | 124 |
| 8/5/94 | RBT | 318254 | 370 | 608 | | | | 235 | 118 |
| | | | 390 | 657 | | | | 236 | 119 |
| | | | 420 | 852 | | | | 235 | 118 |
| | | | 397 | 740 | | | | 238 | 120 |
| | | | 393 | 639 | | | | 220 | 95 |
| | | | 470 | 1230 | | | | 225 | 96 |
| 8/5/94 | RBT | 318255 | 355 | 580 | 8/5/94 | MWF | 318258 | 234 | 117 |
| | | | 425 | 877 | | | | 224 | 102 |
| | | | 380 | 661 | | | | 230 | 110 |
| | | | 400 | 625 | | | | 255 | 164 |
| | | | 376 | 563 | | | | 232 | 109 |
| | | | 440 | 947 | | | | 298 | 274 |
| 8/5/94 | RBT | 318256 | 395 | 613 | | | | 235 | 121 |
| | | | 351 | 468 | | | | 237 | 142 |
| | | | 435 | 1007 | 8/5/94 | MFW | 318259 | 348 | 416 |
| | | | 442 | 1129 | | | | 235 | 128 |
| | | | 427 | 770 | | | | 236 | 124 |
| | | | 474 | 1301 | | | | 305 | 300 |
| 8/13/96 | RBT | 428084 | 281 | 278 | | | | 228 | 105 |
| | | | 240 | 166 | | | | 246 | 148 |
| | | | 271 | 273 | | | | 236 | 116 |
| | | | 242 | 152 | | | | 236 | 118 |
| | | | 328 | 390 | | | | | |

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

| Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) | Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) |
|---------------------|---------|---------------|------------------------|---------------------|----------------------|---------|---------------|------------------------|---------------------|
| Above Nine-Mile Dam | | | | | Little Spokane River | | | | |
| 8/13/96 | MWF | 428087 | 298 | 240 | 8/3/94 | LSS | 318236 | 430 | 825 |
| | | | 336 | 348 | | | | 450 | 855 |
| | | | 386 | 460 | | | | 485 | 1145 |
| | | | 371 | 461 | | | | 460 | 1070 |
| | | | 306 | 247 | | | | 438 | 780 |
| | | | 280 | 200 | 8/13/96 | LSS | 428083 | 461 | 972 |
| | | | 343 | 316 | | | | 446 | 948 |
| | | | 299 | 261 | | | | 426 | 805 |
| 8/13/96 | MWF | 428088 | 350 | 361 | | | | 451 | 1016 |
| | | | 310 | 320 | | | | 480 | 1098 |
| | | | 304 | 268 | 8/3/94 | MWF | 318237 | 324 | 280 |
| | | | 229 | 123 | | | | 310 | 270 |
| | | | 315 | 269 | | | | 326 | 300 |
| | | | 321 | 308 | | | | 305 | 280 |
| | | | 313 | 314 | | | | 290 | 205 |
| | | | 312 | 256 | | | | 342 | 345 |
| 8/13/96 | MWF | 428089 | 349 | 346 | | | | 313 | 285 |
| | | | 321 | 294 | | | | 334 | 350 |
| | | | 325 | 305 | 8/3/94 | MWF | 318238 | 283 | 220 |
| | | | 282 | 211 | | | | 277 | 215 |
| | | | 289 | 262 | | | | 294 | 215 |
| | | | 286 | 253 | | | | 230 | 93 |
| | | | 293 | 251 | | | | 327 | 292 |
| | | | 297 | 241 | | | | 280 | 200 |
| | | | | | | | | 241 | 112 |
| | | | | | | | | 239 | 116 |
| | | | | | 8/3/94 | MWF | 318239 | 325 | 295 |
| | | | | | | | | 277 | 208 |
| | | | | | | | | 217 | 90 |
| | | | | | | | | 224 | 98 |
| | | | | | | | | 287 | 215 |
| | | | | | | | | 294 | 231 |
| | | | | | | | | 305 | 264 |
| | | | | | | | | 305 | 256 |

Appendix C. [continued] Length and Weight Data for Spokane River Fish Species Re-Sampled in 1996

| Date | Species | Sample Number | Mean Total Length (mm) | Mean Weight (grams) |
|----------------------|---------|---------------|------------------------|---------------------|
| Little Spokane River | | | | |
| 8/13/96 | MWF | 428080 | 374 | 499 |
| | | | 275 | 169 |
| | | | 304 | 250 |
| | | | 270 | 193 |
| | | | 267 | 165 |
| | | | 305 | 304 |
| | | | 265 | 176 |
| | | | 256 | 157 |
| 8/13/96 | MWF | 428081 | 222 | 102 |
| | | | 299 | 267 |
| | | | 255 | 142 |
| | | | 275 | 167 |
| | | | 285 | 231 |
| | | | 222 | 101 |
| | | | 262 | 165 |
| | | | 281 | 204 |
| 8/13/96 | MWF | 428082 | 266 | 179 |
| | | | 227 | 103 |
| | | | 254 | 131 |
| | | | 312 | 240 |
| | | | 248 | 129 |
| | | | 329 | 284 |
| | | | 252 | 148 |
| | | | 267 | 167 |

LSS = largescale sucker

RBT = rainbow trout

MWF = mountain whitefish